Rule 21 Working Group Meeting #35 - Agenda
July 31, 2002

San Diego Gas & Electric
8306 Century Park Court
San Diego, CA
Meeting Agenda
9:30 am – 4:00 pm

Combined Group Discussion 9:30 am to 11:00 am

- Introductions, General Housekeeping, & Next Meeting Location : August 27, PG&E, Webster street in Oakland. Plug Power is planning to certify a new inverter (currently being tested by UL).
- Phone participants:
  Lisa Potter from Plug Power – taking over for John Vogel, she is an electrical engineer formerly of Niagara Mohawk. John was a mechanical engineer, is bowing out of interconnection issues. Lisa mentioned that Plug Power is coming out with another inverter, also based on AEI technology.
  Chuck Collins – DOE, Dave Redding - Riverside Public Utility, Paul Sivley – PGE, Werner Blumer - CEC
- Status of Utility Rule 21 Filings (Advice Letters/Petition to Modify) : SDG&E Advice filing has been APPROVED. Additional items were added to the Bin List, and the new Bin List has been emailed to (partial?) group. (List will be distributed prior to next meeting to whole group.)
  SCE has gone through SDG&E version verbatim to have 100% version compatibility (except names, several terms, and code/rule references). PG&E will generate a redline version that shows all PG&E changes from the SCE/SDG&E version. Bear Valley is proceeding to file an SCE/SDG&E verbatim version (with above exceptions).
- Technical Group Status Report
  15% Line Segment screen: What are conditions are beyond Initial Review? Equipment overrating, voltage control, islanding + several others. What level creates concerns? What information or requirements are necessary? Group will complete today. Non-cert. equipment will be discussed today. End date is not certain for work.

- FOCUS Team DG Monitoring Study :

Joe Simpson indicated that they have selected monitoring equipment (Power Measurement Limited ION, not Dranetz-BMI, due to lower installed cost). In the process of making site visits to solidify site selection decisions.

Concerns were expressed that mechanisms for obtaining cost reductions that are stated to be the outcome of the study are not clearly described. Response was that where the data could be used to justify simplified interconnection in similar configurations, the future costs of such interconnections would be reduced.

Purpose – To establish the first baseline on the impacts of a diverse range of DG systems on the grid and vice versa in full commercial situations
Test Guidelines – Developed & approved
Test Plan – Developed & approved
Monitoring Program
Supported by CEC
Cooperation by
Utilities (PG&E, SCE)
Municipalities (LADWP)
Real Energy
Participants
ACRO (BP)
AMD
Loma Linda University Medical Center
Ford
Independent, unbiased nature of the study
**
Instrumentation Installation Methodology - Monitoring at the Point of Common Coupling (PCC) and at the generator
Monitoring Parameter - Capture voltage (l-l) (l-n), Frequency, Current, kW, KVAR, KVA, kWh, kVARh, kVAh, KW, KVA Demands, Power Factor, Harmonics (to 63rd), K Factor, Crest Factor
Sites - Selecting more complex sites with multiple, diverse DG, more than one customer downstream of DG
Database, Data Analysis & Reporting
"Before" and "After" DG snapshots of all captured parameters
Develop database, analysis data and published results with recommendation of any changes to Rule 21 based on study results.
**
Issued Purchase Order to Power Measurements (PM) for the ION 7600 System. The order to Power Measurements followed a long evaluation period where two highly qualified bidders were in contention.
Utilities/Municipalities Sites Selection Distribution

Utilities/Municipalities	No. of Sites
LADWP	1
PG&E	4
Riverside or SMUD	1
SCE	4
SDG&E	2
Total	12

**

DG Technology	No. of Sites	Utility/Municipalities	Status
Diesel Internal Combustion (DIC)		1 Riverside or SMUD (1)	Under Review
Fuel Cell (FC)		3 LADWP (1)*	
SCE (1)			
PG&E (1)	Survey – 6/12/02, Install – Oct 2002		
Survey – 6/27/02, Install – 9/08/02			
Under Review			
Methane Internal Combustion (MIC)		1 PG&E (1)	Under Review
Natural Gas Combustion Turbine (NGCT)		1 PG&E (1)	Survey – 7/30/02, Install – Aug 2002
Natural Gas Internal Combustion (NGIC)		3 SCE (1)	
SDG&E (3)	Under Review		
Under Review			
Micro Turbine (MT, MMT & NGMT)		1 SCE (1)	
LADWP (1)*			
SDG&E (1)	Survey – 7/02/02, Install - 8/26/02		
Survey – 6/27/02, Install – Oct 2002			
Under Review			
Photovoltaic (PV)		2 PG&E (1)	
SCE (1)	Under Review		
Survey – 7/08/02, Install			

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Customer Type	Location	kW	Technology	IC Type	OP Mode
	Riverside or SMUD		DIC		
Convenience Store	SCE – Southgate	14	PV	P	Cogen
Commercial BLDG	LADWP – Los Angeles	120			
	250	NGMT			
FC	P				
P	PS				
PS					
Commercial BLDG	SCE – Irvine	235	FC	P	PS
Government	PG&E – Central Valley	450	MIC/NGIC	P	Cogen
Law Enforcement	PG&E – Bay Area	450	PV	P	Cogen
Manufacturing	PG&E – Sunnyvale	3000	NGCT	P	Cogen
Manufacturing	SCE – Irvine	1275	NGIC	P	Cogen
Manufacturing	SDG&E – Chula Vista	9600	NGIC	P	PS/Cogen
Medical	SCE - Redlands	120	NGMT	P	Cogen
Shopping Center	PG&E – Central Valley	600	FC	P	E/B/I
Waste Water Treatment	SDG&E – Escondido	360	MMT	P	PS

**

Concern in group that line characteristics be accounted for so that they are not confused with DG characteristics. Concern that the information is only for the utilities. Concern that the purpose & end point of the study be known. Concern whether cost of interconnection is affected...how will that be addressed.

- Net Metering Issues
  - Dealing with Hybrid Systems : Disagreement between utilities and ORA on Net Metering. SCE introduced language in their advice letter, not in PG&E & SDG&E . (Tony could not cite—but paraphrased that hybrid systems were not allowed.) PG&E says that they also are not allowing hybrid systems. ORA says that is contrary to the Net Metering legislation. Tom D. says that SCE was concerned about customers getting NEM for natural gas- or other fossil-fired systems. Werner says "hybrid-metered" systems are covered. Microturbine & Solar would be okay as long as there was non-export. Doesn't see a problem. Question whether NEM should be for a location or for an account. City of San Diego would like to use a San Diego site as a

test case. Scott T. suggests an all-day forum on NEM. Objective: 1. What are the rules? 2. ... Scott will coordinate Oct/Nov timeframe.

- Expanded Net Metering Sizing: Nameplate vs. Inverters

  Jerry J. asks how question of size was resolved in the Technical Group: Chuck W. says size = Inverter Nameplate. Question whether to use kVa; not an issue under Rule 21, since limit under the Rule of .95xkVa to limit VARs. Tariffs are not specific at this point; allows utility discretion to protect other customers on a feeder. Tony, ORA: Does anyone disagree that the output is lesser of prime mover or power converter? PG&E: Is this for inverters? There are exceptions—such as fault conditions. Steady-state case there are no exceptions. Cheating can happen. Issue is unresolved, and is still being discussed by technical group. Methods could be established to handle issues—suggestion that Xantrex rep write it up for next time.

- New Business:
  - Potential Rule 21 Certification of Universal DG Protection Devices

Many P1547 working group requirements are in the SEL 547. Many protection features built-in. Designed to simple and inexpensive. SEL-547 = ~$950; SEL-351A = ~$1700. 351-7 = ~$3250; SEL-300G2 = ~$4250. MODBUS protocol okay; EIA-232 port; 485 port. There will be no universal protection device, since each installation will need to be tested. Certification will still be according to installation. A universal device, the group agreed, will NOT lower the cost of interconnection.

Schweitzer SES 547 Multi-Function Protection Relay presentation. Relay is targeted at lower cost installations, and is designed based on requirements.
Power accuracy: 3%+/-5W secondary. Schweitzer representative indicates that this unit is intended for the low cost market… units with capabilities mentioned by Moh are three to five times the cost. This unit not supposed to need re-calibration for the life of the unit. It is brand-new to the market, introduced in July.

See SEL presentation attached at the end of this document.

- Xantrex Inverter Follow-up: Additional Test Results

Mike Behnke introduced a new report from Sandia that indicates that the presence of a distribution transformer does not appear to enhance the ability of the pre-GTI SW inverters to detect an island to the degree previously reported. The new information came from testing typical oil-filled transformers rather than the dry-type transformer previously tested. The actual Q value detectable by the non-GTI SW was not determined for the oil-filled transformers. A teleconference to discuss this issue further was tentatively scheduled for the afternoon of 5 August 2002.

Q-Factor of 2.5 may be too low according to utility protection engineers. Above 3.5 GE study says there will be no anti-islanding. If there is a dedicated transformer, this was thought not to be an issue; now apparently it may be an issue. Bill C. says this must be a case-by-case basis. Tech group must look at Xantrex issue; there is a utility statement on the web that says utilities

are okay with the Xantrex Q-factor. There will be a conference call Monday PM. Endecon will host.

- Does Rule 21 Need a Loss of Synchronism Requirement?

Jim Daly from ASCO asked Chuck to discuss this issue. P1547 had similar requirement, but decided there is no need for a loss of Synch requirement. Other requirements cover this issue (Flicker and ...) ASCO asks that this requirement be removed. Ed Grebel had an issue with removal, but he isn't present.

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- Rule 21 Standard Disconnect Issue

The placement of standard "lockable, visible, disconnects" was discussed. Mike DeMarsi expressed concerns about the physical size of such a switch for large DG. He argued that a lockable circuit breaker—which does not meet the "visible" requirement—should provide sufficient protection in a much more cost effective package. Greg Ball of Powerlight noted that some utility interconnection inspectors have agreed that the language of the Rule is more stringent than is always called for. The cost of routing power wiring from the generator installation (on the roof of a multi-story building, for example) to the meter location is often prohibitive, and distribution panels are often already marked for fire safety disconnects. This issue was tabled for review.

Remarks from Mike D. of Hess: Visual break in the disconnect: Why is this necessary? Could breakout with Lockout Kit be a substitute? Breakers are well tested and established. Visibility and Lockability are issues with PG&E. Mike di'M. says NEC switch in certain position is acceptable as a visible break. Multiple breakers begs questions of "which one to pull?" Other states do not stipulate need for open break. NY says adequate disconnect device that's lockable. Fed stuff is tranmission-level. Could be a union requirement.

- Resolving Electronic Application Form Technical Glitches

Form online has been fixed—according to CEC contractor Conceio...should be downloadable and printable.

Non-Technical Breakout (Rest of the Day with a Lunch Break)

- Utility Rule 21 Updates
  - SCE/SDG&E Advice Letter Filings
  +SDG&E Rule 21 Approved: [original superseded: 1409-E on May 17;]
  1409-EA July 26

+SDG&E 1413 Approved: Compliance Memorandum Account
+SCE Rule Seeks approval: [original superseded: 1630-E June ??;]
to be replaced next week with 1630-EA
+SCE 1633 Approved: Memorandum Account Approved

- PG&E's Petition to Modify Rule 21
+PG&E: Draft July 30,2002;
+PG&E has two versions: one for Advice Letter; one for Petition to Modify. Reason for Petition to Modify rather than Advice Letter: this is a major rule; Energy Division may not be enough buy-off to stand up in court. PG&E Execs will decide which way to go.

- Formal Creation of the Rule 21 Bin List
+SDG&E has sent out an updated bin list that has the SCE/SDG&E accepted bin list items removed (items included in their advice letter filings that came from the bin list were removed)
+Werner B. is going to look at SCE filing in terms of the bin list to make add items to the bin list that have not been addressed
+Bin list will be developed this meeting & next; then a new Compilation doc will be prepared to discuss all bin list items.

Changes written into PG&E Draft Rule 21 are now added to Werner's expanded (8-7-2002) Bin List. PG&E Changes: C.1.d, C.1.d, C.1.e, C.1.f, C.1.f, D.1.a, D.2.d, E.3.a, H. Some overlap with existing list. See Bin List for details.
http://www.overdomain.com/documents

- Regulator Data Requests: ORA and CEC

ORA has asked PG&E to file quarterly reports that are DG lists including e-net. PG&E now drops projects off in next report that are not going forward; they have also been dropping off projects that are on line put them on through end of year; PG&E has not done that, but Jerry J. says they will.

Paul Sivley of PG&E asked whether the PG&E DG list covered all data items required. Scott T. said yes. Cris Cooley said the FOCUS Cost Effectiveness Data gathering effort may require more information to help the Energy Commission determine how cost effective the FOCUS contract has been, whether ratepayer money spent on the support of this Working Group for Rule 21 modification had lowered costs of interconnection. He agreed to work through Jerry J. & Dylan S. for any additional data needed from PG&E.

- Interconnection Application Issues:
  - Project Identification: Service Account vs. Property Location
  - Potential Application Fees for Project Changes

Customers sometimes apply, then increase the project size part way through. There are no rules covering this—no clear policy.

  - Inadvertent Deliveries

- Update on FERC Related Proceedings Related to DG
- Non-bypassable charges an issue. PG&E is petitioning CPUC for clarification on non-bypassable charges and surcharges. Some surcharges are very large and might make projects uneconomic. PG&E had a workshop in May re: FERC NOPR: Generator connection to distribution system is called "Interconnection Facilities" by PG&E; called "Gen Tie Line" in FERC language. Distribution modification called System Upgrades. Who pays over what length of time are issues. ISO needs to do economic evaluation, but is not set up to do that at this time.
- Agreements: PG&E: Approved: Customer Generation Agreement (with 3rd Party Generator on Premisis) and Non-Export; Third Party Generation Agreement non-Export on Generator Customer Premisis. Not yet approved: Inadvertant Export for Customer; Inadvertant Export for 3rd Party.
- Agreements: SDG&E & SCE 5 Agreements in Place

Technical Breakout (Rest of the Day with a Lunch Break)

Continuing Development of Supplemental Review Guidance Document

- Export (Screen 2)

Not discussed, except for comparison between the "non-islanding" decisions in Chuck Whitaker's text and the table in Bill Cook's text.

- Non-certified Equipment (Screen 3)

Moh reviewed this section very briefly. An updated version will be sent out within the next week for comments to be received prior to the next meeting.

- 15% Line Segment (Screen 4)

The majority of this session was devoted to reviewing modifications to Bill Cook's suggested method for presenting the options available in the Supplemental Review. The concept is similar to the Initial Review Process screens, though as the issues are more complex, the logic of each Supplemental Review screen is also more complex. The pass-fail criteria are also more subjective but guide the reviewer as to which issues he or she should consider in a given situation. Appropriate organization of the information will be considered later; for now the group is considering the approach, developing the logic, and discussing the criteria. Finalization of this new approach will impact—and likely simplify—the development of the other Supplemental Review sections.

- SCCR requirements (Screen 7)

Not discussed.

SEL Presentation on Universal Interconnection Device

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SEL-547 Distributed Generation Interconnection Relay

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IEEE P1547 Standard

- IEEE P1547 Draft Standard for Interconnecting Distributed Resources with Electrical Power Systems
- IEEE-P1547 recommends much of the protection and control available in the SEL-547

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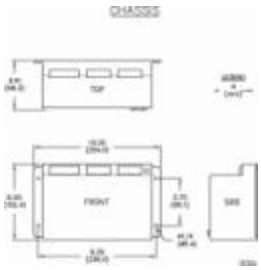
Industrial Power System Protection

Physical Dimensions



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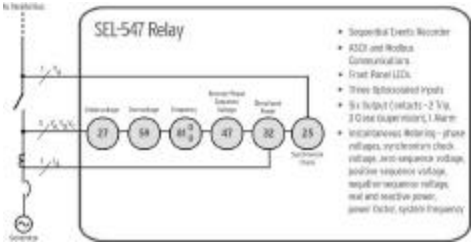
Industrial Power System Protection

Functional Overview



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Front-Panel LEDs Indicate Features (ANSI Device #)

- Undervoltage (27)
- Overvoltage (59)
- Over/Under Frequency (81)
- Reverse-Phase-Sequence (47)
- Directional Power (32)
- Synchronism Check (25)
- Both Sides of Breaker Hot (25 Voltage Hot)

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Industrial Power System Protection

SEL-547 Protection and Control Elements

- Two Undervoltage Elements (dev. 27)
- Two Overvoltage Elements (dev. 59)
  - Detect local or system-side disturbances
- Four Frequency Elements (dev. 81)
  - Configure as overfrequency or underfrequency elements
  - Undervoltage blocking defeats elements
  - Detect local or system-wide disturbances

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Industrial Power System Protection

Front Panel LEDs

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Industrial Power System Protection

SEL-547 Protection and Control Elements - Continued

- Reverse-Phase-Sequence Element (dev. 47)
  - Detects voltage wiring errors
- Directional Power Element (dev. 32)
  - Detects power export violations
  - Detects generator motoring
- Synchronism Check Element (dev. 25)
  - Supervises breaker closing for system restoration, with angle, voltage, and slip frequency checks

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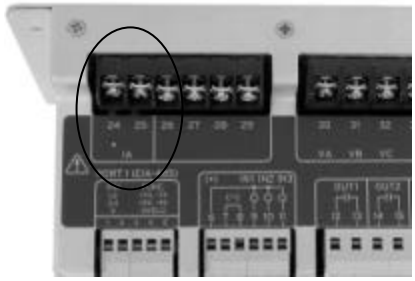
Industrial Power System Protection

Single-Phase Current Input



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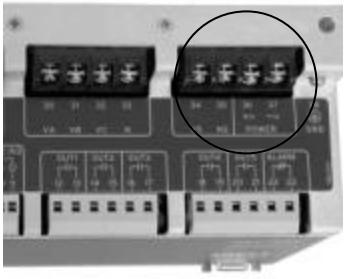
Synch. Check Voltage Input and 12/24 Vdc Power Input



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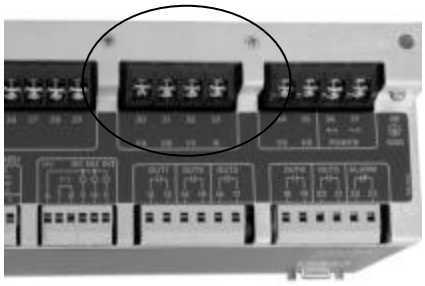
Wye-Connected Voltage Inputs



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Control Inputs/Outputs

- Three Optioisolated Inputs
  - Not used in factory logic
  - Apply 12/24 Vdc whetting voltage
- Six Output Contacts
  - Two trip; three close (supervision)
  - One alarm (relay status)
  - All output contacts are dry and not polarity dependent

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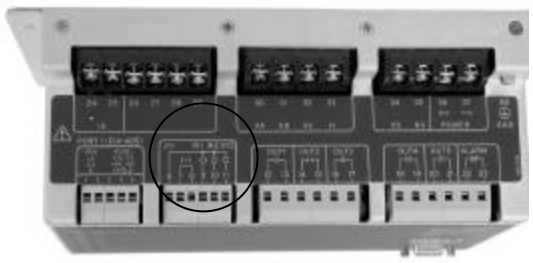
Three-Optoisolated Inputs



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Serial Communications Ports

- EIA-485 located on the top-side panel
  - Modbus® protocol (factory set)
  - Acquire real-time data and automate distributed generation systems
- EIA-232 located on the front panel
  - SEL ASCII protocol (factory set)
  - View information (e.g., settings, metering, or SER data) or change settings

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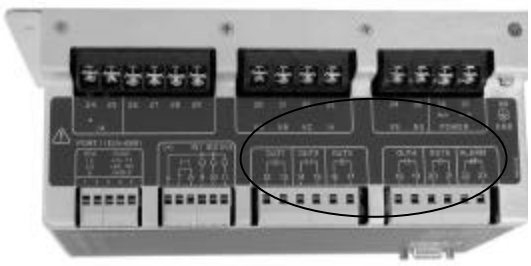
Industrial Power System Protection

Six Output Contacts



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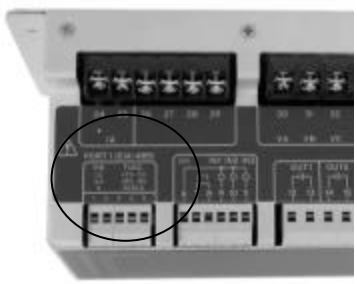
EIA-485 Port



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EIA-232 Port

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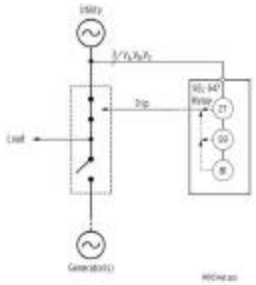
System Disturbance Detected



- Emergency back-up generator (normally off-line)
  - Voltage or frequency elements detect local system "islanding" or system-wide disturbance and the SEL-547 trips the transfer switch
  - Emergency back-up generator brought on-line by separate control

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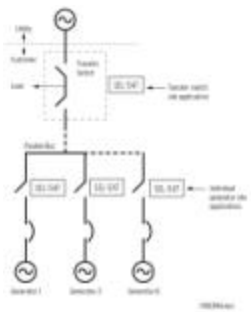
Applications for the SEL-547



- Interconnection protection for:
  - distributed generators
  - distributed resources
  - emergency back-up generators
- Apply at transfer switch site (interconnection between utility and customer)
- Apply at individual generator sites

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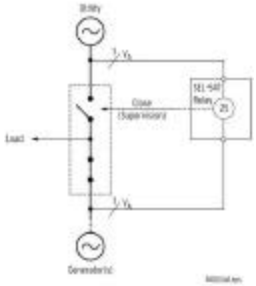
System Restored



- Emergency back-up generator (now on-line)
  - Synchronism check element confirms utility supply and emergency back-up generator are within normal bounds and the SEL-547 issues a close (supervision) signal to transfer switch control
  - Load fed by utility supply again

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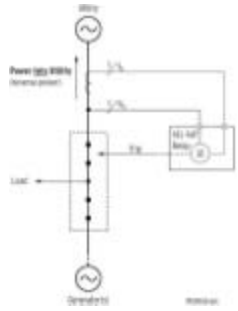
Reverse Power Flow Protection



- Generator operating in parallel mode
  - Operating restriction: No power export to utility
  - Directional power element detects reverse power flow and the SEL-547 trips the transfer switch

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SEL-547 Distributed Generation Interconnection Relay

Utility-Grade Protection for Distributed Generation

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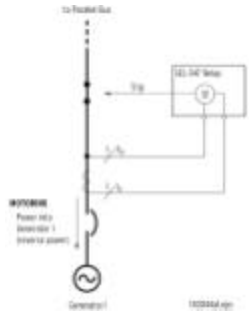
Generator Motoring Protection



- Generator operating in parallel mode
  - For some reason (e.g., generator loses prime mover), system power flows into the generator
  - Directional power element detects reverse power flow and the SEL-547 trips the switch/breaker

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